DelayedArray / HDF5Array update

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1. Recent additions to package DelayedArray

2. Recent additions to package HDF5Array

3. Work in progress and future work

ConstantArray objects (by Aaron)

This would ordinarily take up 8 TB of memory:

```
library(DelayedArray)
CM <- ConstantArray(c(1e6, 1e6), value=NA_real_)
CM
```

```
## <1000000 x 1000000> matrix of class ConstantMatrix and type "double":
##                   [,1]       [,2]       [,3] ...  [,999999] [,1000000]
##       [1,]          NA         NA         NA   .          NA          NA
##       [2,]          NA         NA         NA   .          NA          NA
##       [3,]          NA         NA         NA   .          NA          NA
##       [4,]          NA         NA         NA   .          NA          NA
##       [5,]          NA         NA         NA   .          NA          NA
##        ...           .          .          .   .           .           .
##  [999996,]          NA         NA         NA   .          NA          NA
##  [999997,]          NA         NA         NA   .          NA          NA
##  [999998,]          NA         NA         NA   .          NA          NA
##  [999999,]          NA         NA         NA   .          NA          NA
## [1000000,]          NA         NA         NA   .          NA          NA
```

```
lobstr::obj_size(CM)
```

```
## 1,328 B
```

sinkApply()

`sinkApply()`: a convenience function for walking on a `RealizationSink` derivative for the purpose of filling it with blocks of data

Example: Fill a 1e6 x 1e6 on-disk matrix with random data

```
sink <- HDF5RealizationSink(c(1e6L, 1e6L))  # or TileDBRealizationSink

sink_grid <- defaultSinkAutoGrid(sink)

FUN <- function(sink, viewport) {
    block <- array(runif(length(viewport)), dim=dim(viewport))
    write_block(sink, viewport, block)
}

sink <- sinkApply(sink, FUN, grid=sink_grid)

close(sink)
M <- as(sink, "DelayedArray")
```

rbind(), cbind(), and sparsity

`rbind()` and `cbind()` of `DelayedArray` objects now propagate sparsity

```
tenx1 <- HDF5Array::TENxMatrix("tenx1.h5")  # is_sparse(tenx1) is TRUE
tenx2 <- HDF5Array::TENxMatrix("tenx2.h5")  # is_sparse(tenx2) is TRUE

bigtenx <- cbind(tenx1, tenx2)
is_sparse(bigtenx)  # TRUE

blockApply(bigtenx, FUN, ...)   # will take advantage of sparsity
```

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Recent additions to package HDF5Array

`HDF5Array()`: can now take an URL to a file on Amazon S3 (kind of slow!)

`H5SparseMatrix`: a `DelayedMatrix` subclass for representing and operating on an HDF5 sparse matrix stored in CSR/CSC/Yale format (e.g. 10x Genomics and h5ad formats)

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Work in progress and future work

Work in progress:

`h5summarize(..., op="sum")`: Optimized summarization of an HDF5 dataset or subset:

- Implemented in C (direct calls to HDF5 C lib in *Rhdf5lib*)
- Operates at the level of the physical chunks
- More efficient than `blockApply()`
- Integration to *DelayedArray*/*DelayedMatrixStats*: `h5summarize()` will be used behind the scene by things like `rowVars()`

Future work:

`SparseArray` objects: In-memory sparse representation of arrays of arbitrary dimensions

- Already used internally by block processing of sparse `DelayedArray` objects (current name is `SparseArraySeed`)
- Will go to their own package (currently in `DelayedArray`)
- Implement fast native operations: arithmetic, `Math` group (e.g. `log`), summarization, etc.. This will benefit block processing of sparse `DelayedArray` objects